

Frequency of detection of methicillin-resistant *Staphylococcus aureus* from rectovaginal swabs in pregnant women

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Clinical samples from 250 pregnant women undergoing screening for rectovaginal group B streptococcus colonization were evaluated concurrently for the presence of methicillin-resistant *Staphylococcus aureus* (MRSA). Overall, *S aureus* was detected in 21.6% of the women; 53.7% of the isolates were MRSA. Despite a lack of risk factors for MRSA colonization, rectovaginal MRSA was detected in 10.4% of pregnant women in this study.

Key Words: MRSA; pregnancy; *Staphylococcus aureus*; infection control; contact precautions.

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Over the past decade, the frequency of community-associated methicillin-resistant *Staphylococcus aureus* (CA-MRSA) infections has continued to increase in such groups as competitive sports participants, adolescents, pregnant women, and, more recently, neonates.¹⁻⁷ This increase coincides with an increase in the frequency of CA-MRSA nasal colonization. In Nashville, for example, colonization in healthy children increased more than 10-fold over a 3-year span, such that now nearly 10% of children have nasal colonization with MRSA.⁸

Whether increases in neonatal CA-MRSA disease^{5,9-11} are associated with horizontal transmission from family members and health care workers in the nursery or are related to vertical transmission due to staphylococcal rectovaginal colonization remains unclear. Previous studies, performed before the widespread emergence

of CA-MRSA, demonstrate that vaginal colonization with *S aureus* is not an infrequent event,¹²⁻¹⁴ and the frequency of methicillin-susceptible *S aureus* (MSSA) vaginal colonization has increased in recent years.¹⁵ In addition, a relationship exists between neonatal MRSA infection and maternal MRSA infection; in one study, 21% of neonatal MRSA cases had a history of maternal MRSA infection, compared with 1% of neonatal MSSA cases.⁵ Consequently, the current study was designed to determine the frequency of MRSA and MSSA detection from rectovaginal cultures in a cohort of pregnant women.

METHODS

Pregnant women at 35 to 37 weeks of gestation were identified via group B streptococcus (GBS) rectovaginal screening swabs collected in the Vanderbilt Obstetrics and Gynecology Clinic. The clinic serves women in the greater metropolitan Nashville region and cares for both low-risk and high-risk pregnancies. Each patient was represented by a single rectovaginal swab specimen, and all specimens were collected consecutively from April through August 2006. The swabs were collected by either a health care provider or the patient, following current Centers for Disease Control and Prevention (CDC) recommendations. Electronic medical records (prenatal chart and medical chart) were reviewed for demographic data (ie, age, ethnicity, and parity) as well as risk factors traditionally associated with MRSA colonization and disease (ie, hospitalization in the last 12 months, surgical procedures in the last 12 months, recent antibiotic use, indwelling catheter use, and chronic skin disorders). Determination of specific occupation, including health care worker

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status, was made by review of the social history (which contains a specific field for occupation in the medical history templates used by the clinics) and by employer data provided in the billing portion of the electronic medical record. This method resulted in unequivocal determination of occupation in 83% of the women (208/250). After the processing of GBS swabs was complete, all remaining Lim broth (modified Todd-Hewitt broth) was provided for detection of *S aureus*.

An aliquot of Lim broth that had been incubated at 37°C for 18 hours was plated onto mannitol salt agar (Remel, Lenexa, KS), a selective medium for staphylococci. After incubation at 37°C for 48 hours, the plates were inspected for typical colony morphology of *S aureus*. Putative *S aureus* isolates were subcultured onto tryptic soy agar with 5% sheep's blood (Remel) and then incubated at 37°C for 24 hours. Coagulase testing by latex agglutination (Staphaurex; Remel) confirmed the presence of *S aureus*. MRSA isolates were identified by resistance to ceftiofloxacin, and the presence of *mecA* was detected by polymerase chain reaction (PCR).¹⁶ Detection of the Panton-Valentine leukocidin (PVL) gene locus was done using previously described oligonucleotide primers,¹⁷ and SCC*mec* type was determined by the multiplex typing strategy of Oliveira and deLancastre¹⁸ and *ccr* gene typing where appropriate.¹⁹

The sample size for this study was based on the number of samples available during the study period of April through August 2006. All statistical analyses were performed using Stata 8.0 for Windows (Stata-Corp, College Station, TX). Categorical data were analyzed using Pearson's χ^2 test and, where appropriate, Fisher's exact test. Univariate logistic regression was used to identify risk factors associated with staphylococcal colonization. The Vanderbilt Medical Center's Institutional Review Board approved the study design.

RESULTS

A total of 250 consecutive pregnant women with GBS screening specimens were included in the study. Their median age was 28 years, and 47% were white, 32% were black, and 10% were Hispanic. The majority of the women (67%) were multiparous, and 7.6% were health care workers. Eight women (3%) had a history of previous staphylococcal infection by medical chart review.

GBS colonization was detected in 66 women (26.5%; 95% confidence interval [CI] = 21.0% to 32%). *S aureus* rectovaginal cultures were positive in 55 women (22%; 95% CI = 16.9% to 27.1%); 29 women (11.6%; 95% CI = 7.7% to 15.5%) had cultures positive for MSSA, and 26 (10.4%; 95% CI = 6.7% to 14.1%) had cultures positive for MRSA. No significant relationship between GBS colonization and either overall *S aureus*

or MRSA detection was found. Univariate analysis revealed no association between positive staphylococcal or MRSA culture and age, ethnicity, parity, history of staphylococcal infection, antibiotic use in the previous 6 months, or current employment status. Epidemiologic characteristics and frequency of MRSA detection did not differ between those in whom occupational status could not be definitively ascertained and the remainder of the study population. One woman with a positive rectovaginal culture for MRSA developed a postpartum cesarean surgical site infection with MRSA.

Determination of SCC*mec* type revealed the presence of an SCC*mec* IV cassette in 7 women (27% of MRSA carriers). The remaining 19 MRSA isolates contained SCC*mec* type II or III or were nontypeable by multiplex PCR. The PVL gene locus was detected in 6 of the 7 SCC*mec* IV isolates, but was not found in any isolates carrying a non-type IV SCC*mec* cassette.

DISCUSSION

In our cohort of 250 pregnant women, 10.4% had rectovaginal MRSA. There was no correlation between GBS carriage and positive staphylococcal cultures. A minority of MRSA isolates (27%) had the typical SCC*mec* cassette found in CA-MRSA strains; similarly, only 6 of 26 isolates had PVL.

The frequency of positive MRSA rectovaginal cultures in this study was higher than that reported previously in New York and Alabama. A 2005 study of nearly 3000 pregnant women in New York reported an MRSA rectovaginal colonization rate of 0.5%.²¹ An Alabama study in 2003 to 2006 found that 3.5% of nearly 6000 women had vaginal colonization with MRSA.²⁰ It appears that geographic variability may exist with regard to rectovaginal MRSA detection. Whether the detection of rectovaginal *S aureus* is dependent on ethnicity, climate, socioeconomic status, or other, as-yet unknown factors remains the topic of ongoing study.

We found no relationship between detection of rectovaginal *S aureus* and GBS colonization in our cohort. Both Andrews et al²⁰ and Chen et al²¹ have reported a positive correlation between staphylococcal colonization and GBS carriage, although the mechanism of this potential interaction is unknown. Interestingly, Chen et al²² found a negative correlation between CA-MRSA and GBS (despite a positive correlation between MSSA and GBS). Whether the differences between the studies are associated with sample size, ethnic or geographic variability, or seasonal variation in bacterial colonization is unknown; prospective studies are underway to elucidate these complex issues of bacterial colonization.

As with any retrospective study, the present study has some limitations. Because we did not have the

ability to collect information on the neonates born to the women in this study, any potential impact on neonatal health is unknown, although our group is currently conducting a prospective trial investigating the relationship between maternal *S aureus* colonization and neonatal colonization and health. Second, because information about the women was collected by chart review, not personal interview, the potential risk factors for staphylococcal colonization may have been underestimated. Finally, due to the use of combined rectovaginal specimens, distinctions cannot be drawn between these potentially discordant sites. It is important to note that this method of rectovaginal culture collection is standard, however. As an increasing number of clinical laboratories report positive *S aureus* cultures from these samples, we will need to know considerably more about their clinical importance.

Our findings have important implications for maternal and neonatal health. Rectovaginal MRSA was detected in 1 of 9 women; therefore, to the extent that a positive rectovaginal culture represents true colonization that could persist through the last month of pregnancy, many infants potentially would be exposed to MRSA during delivery. Whether this persistent colonization occurs, and whether any such exposure would result in either neonatal MRSA colonization or disease is unknown. Prospective studies of colonization and disease in mothers and their infants are a critical next step in gaining more insight into the epidemiology of perinatal staphylococcal colonization and disease.

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